CLAIMS

1. A system for producing corrugated pipe by maneuvering paired molds about a die assembly generally disposed about a system axis and having a paired mold receiving region, a paired mold reference region, an annular die nozzle spaced from said reference region at the entrance of a forming tunnel region defined by an abutting sequence of paired molds extending to a forming tunnel exit, comprising:

a plurality of paired molds, each mold having a generally semi-cylindrically configured corrugate mold profile and dynamically connectable with a vacuum source and a cooling fluid, each said mold being supported upon a carriage assembly having a first locus of travel generally parallel with said axis and a second locus of travel generally transverse to said axis extending between mold defining and release orientations and each said carriage assembly having a connector assembly drivable to move said mold in a direction generally parallel with said axis;

a translation assembly extending in parallel relationship with said axis generally from said reference region to said forming tunnel exit location and engageable in driving relationship with the connector assemblies of said paired molds to effect their movement through said forming tunnel region along said first locus of travel when their associated carriage assemblies are in said mold defining orientation;

first and second mold return assemblies each spaced outwardly from said axis and configured to receive one mold of each mold pair at a respective first and second receiving position and to drivably move each said received mold to respective first and second queue regions having respective first and second forwardmost feed positions and to move each mold at said first and second forwardmost feed positions to respective first and second acquisition positions;

first and second release assemblies respectively drivably engageable with one mold of a said mold pair generally subsequent to movement of said mold pair through said forming tunnel region and configured to drive the carriage assembly of each said mold along said second locus of travel into said release orientation and move said molds to respective said first and second receiving positions;

first and second mold feed assemblies configured to move the molds of a mold pair from respective said first and second acquisition positions to a paired mold receiving region; and

a mold positioning assembly engageable with a mold pair at said receiving region and configured to move said mold pair at said receiving region into abutting engagement with a mold pair located at said reference region.

2. The system of claim 1 in which:

said first and second return assemblies are configured to maneuver respective said mold carriage assemblies along said second locus of travel into said mold defining orientation.

3. The system of claim 1 in which:

said translation assembly comprises a screw assembly having a screw axis generally parallel with said system axis and drivably rotatable about said screw axis; and

each said mold connector assembly is configured as a partial follower nut engageable in driven relationship with said screw assembly.

4. The system of claim 3 in which:

said screw assembly is configured having a screw thread pitch; and

said partial follower nut is configured with nut threads having a thread pitch corresponding with said screw thread pitch.

5. The system of claim 4 in which:

each said carriage assembly is configured having rearward and forward bumpers having abutment surfaces wherein said mold positioning assembly effects the abutting engagement of the abutment surfaces of forward bumpers of a mold pair at said receiving region with the abutment surfaces of rearward bumpers of a mold pair at said reference region, said abutment surfaces of said rearward and forward surfaces being spaced apart along said first locus of travel a reference distance effective to locate said nut threads in continuous pitch relationship with said screw thread pitch.

6. The system of claim 5 in which:

either said reference distance or the sum of reference distances for a sequence of mutually abutting surfaces of rearward and forward bumpers is an integer multiple of said thread pitch.

7. The system of claim 1 in which:

each said mold supporting carriage assembly comprises a primary carriage having one or more wheels effective to transport said carriage assembly along said first locus of travel, and a secondary carriage coupled in supporting relationship with a said mold movable upon said primary carriage along said second locus of travel and having a follower extending therefrom;

said translation assembly further comprises first and second main cam tracks generally in parallel with and spaced transversely from said axis and respectively receiving a said follower of a said carriage assembly of one mold of a mold pair during movement thereof from said reference region and generally through said forming tunnel region to respective first and second main cam track termini, said first and second main cam tracks being transversely located to retain said carriage assembly in said mold defining orientation.

8. The system of claim 7 in which:

said first and second main cam tracks are configured having two generally parallel elongate main cam members spaced apart to receive a said follower, the transversely outwardly disposed main cam members being moveable transversely outwardly from said axis against a spring bias.

9. The system of claim 7 in which:

said first and second release assemblies are configured to engage the primary carriages of the molds of a said mold pair as it emerges from said forming tunnel exit to effect movement thereof along said first locus to respective first and second pick-up regions and thence to move said primary carriages mutually oppositely transversely to said system axis to respective said first and second receiving positions.

10. The system of claim 9 in which:

said translation assembly further comprises first and second main rail assemblies generally in parallel with, spaced transversely from and generally extending from adjacency with said reference region to respective said first and second pick-up regions and configured to receive said primary carriage one or more wheels.

11. The system of claim 10 in which:

said first and second release assemblies further comprise respective first and second release cam tracks having entrances at respective said first and second main cam track termini and extending mutually diagonally outwardly from said system axis for receiving a said secondary carriage follower and effecting the movement of an associated secondary carriage along said second locus of travel toward said release orientation.

12. The system of claim 11 in which:

said first and second release cam tracks are configured having two generally parallel release cam members spaced apart to receive a said follower.

13. The system of claim 10 in which:

said first and second release assemblies comprise respective first and second puller conveyor assemblies having respective first and second engagement components each engageable with a said primary carriage as a said mold pair is generally adjacent said forming tunnel exit and drivably movable therefrom to respective said first and second pick-up regions; and

first and second recovery trolleys drivably movable generally transversely to said system axis between respective said first and second pick-up regions and respective said first and second said receiving positions, each said first and second recovery trolley being configured to receive a said primary carriage and the follower of a corresponding said secondary carriage.

14. The system of claim 13 in which:

said first and second release assemblies further comprise respective first and second release rail assemblies generally transversely oriented with respect

to said system axis and extending respectively between said first and second pick-up regions and said first and second receiving positions;

said first and second rearward trolleys are movably supported upon two or more recovery trolley wheels rotationally supported by respective said first and second puller rail assemblies; and

further comprising first and second recovery trolley drive assemblies configured to drivably move respective said first and second recovery trolleys between said first and second pick-up regions and said first and second receiving positions;

15. The system of claim 14 in which:

said first and second release rail assemblies further comprise respective first and second recovery trolley cams extending respectively between said first and second pick-up regions and said first and second receiving positions; and

said first and second recovery trolleys are configured having respective first and second recovery trolley cam followers respectively guidably engageable with said first and second recovery trolley cams.

16. A mold for forming corrugated pipe from thermoplastic material, comprising:

a generally semi-cylindrically shaped mold body disposed about a mold set axis, said mold body having an internal mold cavity region configured with an outwardly depending sequence of mold crests spaced apart to define a sequence of inwardly depending vacuum support regions, said mold body having an outward surface with outwardly disposed annular standoff structures spaced apart to define cooling regions;

a sequence of annular insert components, one of each being positioned over a said inwardly depending vacuum support region to form a mold valley and define a vacuum cavity with vacuum openings positioned to draw said thermoplastic material into said mold valley; and

a cover plate assembly connected across said mold body standoff structures to define one or more fluid receiving cooling chambers.

17. The mold of claim 16 in which:

said insert components are configured with oppositely disposed width defining edges; and

said vacuum openings are formed within one or both of said edges.

18. The mold of claim 17 in which:

said vacuum openings are configured as notches defining slit-shaped openings with the surface of an adjacent said mold crest.

19. The mold of claim 16 in which:

each said insert component is connected over a said vacuum support region by a plurality of screws extending through said mold body and said vacuum support region from an oppositely disposed said cooling region.

20. The mold of claim 16 further comprising:

a mold vacuum manifold located at said mold body outward surface and configured as a sequence of spaced apart vacuum passages each engageable in vacuum communication between a said vacuum cavity and a vacuum source.

21. The mold of claim 20 in which:

said vacuum passages are configured as a linear sequence of bores arranged normally to said mold set axis.

22. The mold of claim 16 in which:

said generally semi-cylindrically shaped mold body extends along said mold set axis between oppositely disposed generally flat mold side surfaces, and extends about said mold set axis between oppositely disposed generally flat mold mating surfaces;

a said generally flat mold side surface being configured with a seal retaining groove substantially extending between said mold mating surfaces; and

one or more said generally flat mating surfaces being configured with a seal retaining groove substantially extending between said oppositely disposed mold side surfaces.

23. The mold of claim 16 in which:

said generally semi-cylindrically shaped mold body extends about said mold set axis between oppositely disposed mold mating surfaces;

each said annular standoff structure comprises two portions each generally extending from the vicinity of a said mold mating surface to an air diversion portion;

said fluid is air; and

said cover plate assembly comprises two cover plate components each coupled to said standoff structures and configured to provide an air outlet in the vicinity of a said mold mating surface and extending to define an air inlet adjacent said air diversion portion.

24. The mold of claim 16 in which:

said generally semi-cylindrically shaped mold body extends about said mold set axis between oppositely disposed mold mating surfaces; and

further comprising a carriage assembly connected in supporting relationship with said mold body outward surface in the vicinity of a said mold mating surface and having a first locus of travel generally parallel with said mold set axis and a second locus of travel transverse to said mold set axis.

25. The mold of claim 16 in which:

said generally semi-cylindrically shaped mold body extends along said mold set axis between oppositely disposed mold side surfaces;

said mold body sequence of spaced apart mold crests extend from the vicinity of one said mold side surface to the commencement of a bell cavity extending, in turn, to the vicinity of a said mold side surface opposite said one side surface;

said mold body outward surface is configured having one or more outwardly depending wall pairs defining vacuum support regions;

one or more bell vacuum cover components each being positioned within a said outwardly depending wall pair of said vacuum support regions to define an outward vacuum cavity;

a bell mold insert component having a bell defining mold profile positioned within said bell cavity and connected to said mold body internal mold cavity region and having one or more vacuum openings communicating with a said outward

vacuum cavity positioned to draw said thermoplastic material toward said bell defining mold profile.

26. The mold of claim 25 in which:

each said cover extends along said mold set axis between oppositely disposed edge surfaces located adjacent said wall pairs and each being configured to retain a sealing gasket in sealing contact with a wall of said wall pair.

27. The mold of claim 25 further comprising:

a mold vacuum manifold located at said mold body outward surface and configured as a sequence of spaced apart vacuum passages each engageable in vacuum communication between a said outward vacuum cavity and a source of vacuum.

28. A system for providing corrugated pipe by maneuvering paired molds about a die assembly generally disposed about a system axis, comprising:

a plurality of paired molds, each mold having a generally semi-cylindrically configured corrugate mold profile and dynamically connectable with a vacuum source and a cooling fluid, each said mold being supported upon a carriage assembly having a rail mountable primary carriage with a first locus of travel generally parallel with said axis and a secondary carriage with a second locus of travel generally transverse to said axis extending between mold defining and release orientations and each said carriage assembly having a connector assembly drivable to move said mold in a direction generally parallel with said axis;

first and second feed assemblies extending generally transversely to said system axis from respective first and second acquisition positions to a paired mold receiving region generally aligned with said system axis, each said first and second feed assembly being configured to acquire a mold of a mold pair at a respective said first and second acquisition position and move it into paired relationship establishing a said mold pair at said receiving region;

a translation assembly generally extending in parallel with said axis drivably engageable with the connector assemblies of the said primary carriages of a mold pair at a reference region to establish a forming tunnel region as a sequence of

mutually adjacently disposed paired molds moving in driven relationship with said translation assembly along said primary carriage first locus of travel;

a mold positioning assembly generally located at said receiving region and configured to move a mold pair positioned thereat into abutting adjacency with a said mold pair at said reference region;

first and second release assemblies respectively drivably engageable with one mold of a said mold pair subsequent to movement of said mold pair through said forming tunnel region and configured to drive the secondary carriage of each said mold along said second locus of travel into said release orientation and move said molds to respective first and second receiving positions; and

first and second mold return assemblies each spaced outwardly from said axis and configured to receive one mold of each mold pair at a respective said first and second receiving position and to drivably move the primary carriage of each said received mold to respective first and second queue regions having respective first and second forwardmost feed positions adjacent respective said first and second acquisition positions and further configured to move each mold of a mold pair having a mold at said first and second forwardmost feed positions into respective said first and second acquisition positions.

29. The system of claim 28 in which:

said first and second return assemblies are configured to maneuver the said secondary carriages along said second locus of travel into said mold defining orientation.

30. The system of claim 28 in which:

said mold positioning assembly comprises first and second pusher assemblies each configured to move a respective mold of a mold pair synchronously into said abutting adjacency with a mold pair at said reference region.

31. The system of claim 28 in which:

said first and second return assemblies are each configured with first and second spaced apart return rails extending from respective said first and second receiving positions to respective said first and second forwardmost feed positions, said first and second return rails being configured to movably support a said primary

carriage, and further comprising respective first and second rail conveyor assemblies engageable with a said primary carriage at a respective said first and second receiving position and configured to move a said engaged primary carriage into a respective said first and second queue region.

32. The system of claim 31 in which:

said first and second rail conveyor assemblies are further configured to engage a primary carriage located at respective said first and second forwardmost feed positions and move it into respective said first and second acquisition positions.

33. The system of claim 31 in which:

said first and second rail conveyor assemblies are configured to engage and move three adjacent said primary carriages including primary carriages at said first and second forwardmost feed positions at respective said first and second queue regions.

34. The system of claim 33 in which:

first and second rail conveyor assemblies are configured to engage said three adjacent primary carriages in a manner mutually spacing them apart a queue distance.

35. The system of claim 34 in which:

said queue distance is about one inch.

36. The system of claim 31 in which:

said first and second return assemblies further comprise respective first and second arrays of parking assemblies configured to engage and hold stationary those primary carriages located at respective first and second queue regions when not engaged with a respective said first and second rail conveyor assembly.

37. The system of claim 28 in which:

each said primary carriage is configured having two or more wheels effective to transport said carriage assembly along said first locus of travel; and

each said secondary carriage is mounted for movement upon a said primary carriage along said second locus of travel in driven relationship with a follower extending therefrom.

38. The system of claim 37 in which:

said first and second return assemblies are each configured with first and second spaced apart return rails extending from respective said first and second receiving positions to respective said first and second forwardmost feed positions and configured to movably support said primary carriage two or more wheels.

39. The system of claim 38 in which:

said first and second return assemblies further comprise respective first and second return transition cam tracks having entrances at respective said first and second receiving positions and extending mutually diagonally inwardly toward said axis to respective first and second return transition exits and configured to receive a said secondary carriage follower in drive relationship to effect movement of a secondary carriage from said release orientation toward said mold defining orientation.

40. The system of claim 39 in which:

said first and second return assemblies further comprise respective first and second return cam tracks generally in parallel with said system axis extending from respective said first and second transition exits to respective said first and second forwardmost feed positions and configured to receive a said secondary carriage follower to effect retention of a corresponding said secondary carriage in said mold defining orientation.

41. The system of claim 40 in which:

said first and second feed assemblies comprise respective first and second feed trolleys drivably moveable between respective said first and second acquisition positions and said paired mold receiving region, each said first and second feed trolley being configured to receive a said primary carriage and the follower of a corresponding said secondary carriage.

42. The system of claim 41 in which:

said first and second feed assemblies further comprise respective first and second feed rail assemblies generally transversely oriented with respect to said system axis and extending respectively between said first and second acquisition regions and said paired mold receiving region;

said first and second feed trolleys are movably supported upon two or more feed trolley wheels rotationally supported by respective said first and second feed rail assemblies; and

further comprising first and second feed trolley drive assemblies configured to drivably move respective said first and second feed trolleys between said first and second acquisition regions and said paired mold receiving region.

43. The system of claim 42 in which:

said first and second feed assemblies further comprise respective first and second feed trolley cams extending respectively between said first and second acquisition regions and said receiving region; and

said first and second feed trolleys are configured having respective first and second feed trolley cam followers respectively guidably engageable with said first and second feed trolley cams.